Richmond Refinery LPS Bulletin – Reliability

Turbulence induced NH_4HS Piping Leak

Impact ERM: 38022

Location:
Hydroprocessing ABU –
South ISOMAX – 8 Plant

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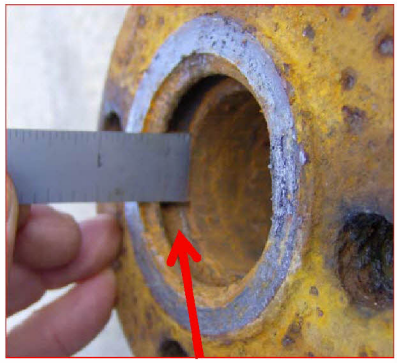
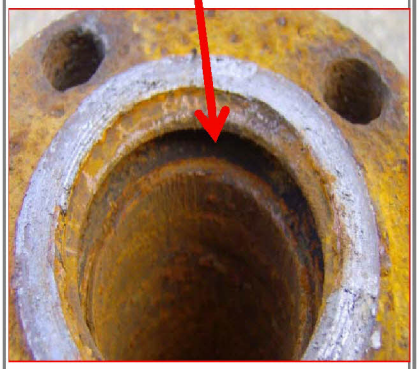
Reference:
Investigation # 23615



Washed out area between socket-welded flange and pipe.



Tenets of Operations Violated: -

Tenet #10 – Always involve the right people in decisions that affect procedures and equipment.

Incident Description:

On 5/21/2012, South Isomax operations reported a pinhole leak at a 1- ½" 150# socket welded flange to pipe weld between E-831 and LC-831 in the 8 plant (NH3-H2S Recovery Unit). The plant was shutdown to allow the leak to be isolated and repaired.

Investigation Findings:

1) The design gap of 1/8" between the socket welded flange and the pipe creates a crevice and a turbulent area. This service contains (ammonium bisulfide) NH_4HS, and as per API 571, NH_4HS corrosion increases with concentration and turbulence.
2) This circuit has an abundance of corrosion monitoring locations (CMLs), and although there is an appropriate inspection technique of radiography that can detect corrosion and thinning, the damage at this location is not able to be detected through this radiography technique (i.e., such non-intrusive inspection techniques do not work in this situation due to the location of the corrosion).
3) The upstream exchanger (E-831) has an Inconel bundle and downstream (E-820) inlet is fabricated from Hastelloy C-276.

Lessons Learned / Business Practices:

1) Crevices should be minimized in process streams with turbulent high NH_4HS concentrations.
2) When upgrading materials in equipment (i.e., E-831 and E-820), consideration should be given to the condition of the piping between the equipment.

What Worked Well:

1) The leak was isolated and the flange was replaced without incident.

Recommendations:

1) Evaluate the NH_4HS piping design criteria and redesign the system to minimize corrosion due to NH_4HS and turbulent conditions.
2) Make the system available for inspection in order to investigate the entire system to determine that there is no imminent leak potential in 8 plant.
3) Evaluate whether there is a need to inspect similar plants (e.g., at the Richmond Refinery, it is 18 plant) for similar scenarios and inspect such plants to the extent necessary.